The Effect of Warfarin Anticoagulation and INR Intensity upon Hematoma Volume in Patients with Intracerebral Hemorrhage

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Introduction: Intracerebral hemorrhage (ICH) is estimated to occur in 67,000 Americans annually. Among patients with ICH warfarin use prior to onset leads to greater mortality. We sought to determine whether warfarin use is associated with larger hematoma size, which might explain this excess mortality. **Methods:** We identified all patients hospitalized with ICH in the five-county Greater Cincinnati area from 1/05-12/05 by reviewing ICD-9 codes 430-436 at all regional hospitals. Hematoma volumes were measured using the first available CT or MRI scan. Volumes were log-transformed for normality. A generalized linear model was constructed to determine whether international normalized ratio (INR) influenced ICH volume after adjusting for other factors such as patient age, race, and hematoma location. In this model INR level was stratified as < 2, 2-3, and > 3. **Results:** There were 263 patients with ICH, 52 of who were taking warfarin. In univariate comparison, patients on warfarin had a greater mean ICH volume than patients not taking warfarin (22.6 cc (4.9) vs. 12.2 cc (6.1), p=0.025). Results of the model are shown below.

	Estimate	Antilog[†]	Lower CI	Upper CI	p-value
Intercept*	2.75	15.61	11.52	21.14	<0.001
INR 2-3	-0.37	0.69	0.34	1.39	0.304
INR > 3	1.02	2.77	1.23	6.23	0.014
Lobar location	0.54	1.72	1.09	2.70	0.020
Brainstem location	-1.80	0.16	0.08	0.35	<0.001
Cerebellar location	-0.07	0.94	0.46	1.89	0.854
Onset to scan^	-0.01	0.99	0.98	0.99	<0.001

*Deep cerebral location with INR < 2.

[†]To approximate volume in cubic centimeters, multiply the intercept antilog by the antilog of interest.

^ For each hour from onset to first CT or MRI scan.

Conclusions: Warfarin use is associated with larger initial ICH volumes. However, this effect appears to occur only for INR values >3. Larger ICH volume among patients using warfarin likely accounts for part of the excess mortality among these patients.